

10µm fuel oil filters

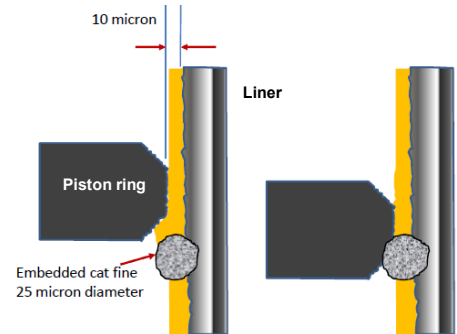
Improving engine lifetime with better protection
against catalytic fines

Thomas Semeraro
Regional Business Manager – Filtration, North East Asia



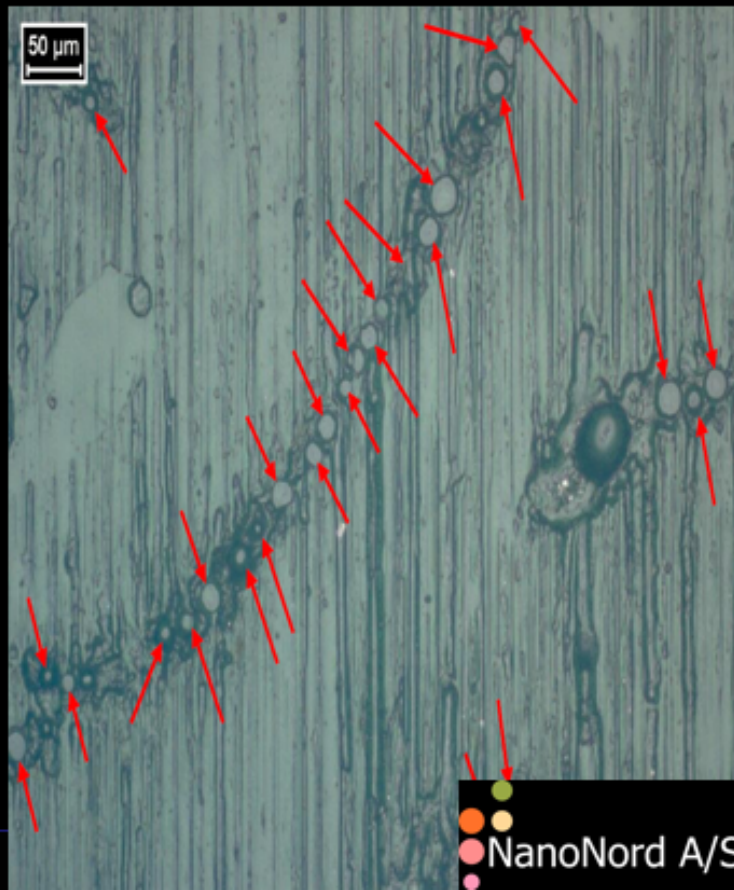
The threat of Cat Fines

- * Cat Fines are very hard: they can get embedded in engine components and cause severe abrasive wear to:
 - Cylinder liner and piston rings
- * Cat Fines vary in size but those larger than $10\mu\text{m}$ can be particularly harmful.
- * Cat Fines can also affect fuel pumps, injectors and valves.



How big is the problem with CF?

- In a 3 years period we have investigated 226 high wear cases.
- In 86% of all cases, high CF was found.
- Embedded Cat Fines higher the 200 CF/cm² result in high abrasive wear.
- The av. on 190 vessels were as high as 1,400 CF/cm².
- In conclusion, Cat Fines are a huge problem to shipping



Recommendations (1)

• MAN D&T: Service letter SL2017-638



SL2017-638

Service Letter SL2017-638/DOJA

MAN Diesel & Turbo



Dear Sirs,

Abrasive particles entering the combustion chamber of two-stroke diesel engines are a cause of wear. Cat fines (catalytic fines) are small, very hard particles originating from the refining process. In case of insufficient cleaning onboard, cat fines may enter the engine with the fuel and cause wear. The latest ISO marine fuel standard specifies levels of up to maximum 80 ppm Al + Si in the fuel (ISO 8217). Such a level would cause high wear compromising reliability in the combustion chamber, and as the fuel must be cleaned on board the ship before it reaches the engine.

This Service Letter specifies the recommended maximum acceptable level of cat fines entering the engine, which is as follows:

- Always keep the level as low as possible and, max. at 10 ppm Al + Si at engine inlet for short periods.

Some guidelines on optimal operation are also given:

- Remove the cat fines from the fuel by setting a high temperature trim, WPC) and a low flow in the fuel separator.
- Enable proper cleaning of the tanks in service by making the overflow pipe in the service tank go to the bottom of the tank, and/or by using a separate line to recirculate the fuel to the settling tank.
- To be warned when the fuel system is not operating optimally, a 10 µm absolute fine filter should be installed in front of the engine.

More detailed information can be found in Ref. [1]. For questions or inquiries regarding the recommendations in this letter, contact our Question Department at: ask@man-dieselturbo.com

Yours faithfully,


Mikael G. Jensen
Vice President Engineering


Sigurd Solberg
Senior Manager Operation

Action code: WHEN CONVENIENT

Cleaning of Heavy Fuel Oil and Maximum 0.10% Sulphur Fuels
How to remove cat fines

SL2017-638/DOJA
February 2017

This SL replaces SL2005-452/KEA

Concerns

Owners and operators of MAN B&W two-stroke marine and stationary diesel engines.

Summary

Cat fines are small, very hard particles found in marine fuel. Cat fines can wear the engine down very fast, and they must be removed from the fuel by the fuel cleaning system on board the ship.

Recommendation:

Max. 10 ppm Al + Si at engine inlet for short periods.



Cat fines (Al + Si) content entering the engine

Concerns

Owners and operators of MAN B&W two-stroke marine and stationary diesel engines.

Fuel fine filter in front of engine

Removal of cat fines from the fuel has to be done in fuel separators because of the substantial amount of dirt and cat fines present in the fuel.

However, as described above, a number of factors may impact the separation efficiency. **Therefore, to protect the engine, we specify a 10-µm fine filter before the engine as standard.** **The filter should be a max. 10-µm (absolute) full-flow automatic back-flushing filter positioned in the high-temperature fuel recirculation system, see Fig. 8. Alternatively it can be positioned in the supply system.**

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Recommendations (2)

- **Wärtsilä:** Technical bulletin RT-140 29/11/2012



RT-140



Wärtsilä low-speed engines
Services 2-stroke

TECHNICAL BULLETIN

RT-140
Issue 1, 29-11-2012

Catalyst fines in fuel oils

Information to all Owners and Operators of all
Wärtsilä 2-stroke engines

Heat opportunity

Introduction

Catalyst fines in fuel oils might lead to high piston ring and cylinder liner wear.

Current situation

Bunkered fuel oils often contain catalyst fines of a size which exceed the limits given in Wärtsilä recommendations at engine inlet.

Solutions

To avoid excessive wear on piston rings, cylinder liners and other moving engine parts in contact with fuel oil, the guidelines as described in this bulletin must be followed. Especially important is the correct fuel oil treatment.

Notes

Wärtsilä recommends installing a 10 micron filter in order to minimize the number of the most dangerous catalyst fines in the fuel oil and to indicate a proper separation efficiency. Even with a 10 micron filter a 100% elimination of catalyst fines cannot be achieved.

This Technical Bulletin supersedes Service Bulletin (S-B), dated 26.10.00, entitled "Catalyst Fines in Heavy Fuel Oil". It also supersedes Service Letter RT-01/06, dated 27.01.2006, entitled "Catalytic Fines and Separation Efficiency".

Information to all Owners and Operators of all Wärtsilä 2-stroke engines

Solutions

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Notes

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Recommendations (3)

- MAN D&T: Service letter SL SL2016-615/JFH



MAN Service
Letter

Service Letter SL2016-615/JFH

MAN Diesel & Turbo



Dear Sirs

MAN Diesel & Turbo has observed a number of incidents with high wear rates and damage to the fuel injection pumps / fuel injectors after only a few hundred running hours. The poor performance of worn fuel injection pumps / fuel injectors affects the overall performance of the engine and causes the onset of fouling of the combustion chamber, exhaust gas ducts and turbine section of the turbocharger.

In order to maintain a trouble-free and safe operation of the engine MAN Diesel & Turbo requires that the onboard fuel oil cleaning system is able to bring down the particle content of burners fuel oil from 80 ppm to 20 ppm and specifically the catalytic fine content to maximum 15 ppm with a maximum particle size of 5 microns thereby defining the efficiency of the system. If fuel oil with a lower content of particles are burned consequently a lower level of particles will remain after treatment.

To ensure the correct cleanliness of the fuel oil and thereby protect the auxiliary engines against abrasive particles and impurities in the fuel oil, a 10 µm absolute/sphere passing mesh automatic backflush filter must be installed in the fuel oil booster/circulation system before the branch off to each auxiliary engine. The automatic backflush filter will also serve as an indication of failures in the fuel oil cleaning system and it removes self-generated contamination in the fuel oil booster/circulation system. Installing the 10 µm backflush filter has in more cases extended the service hours of the fuel injection nozzles from as low as 400 to at least 8000 hours.

Yours faithfully


Michael L. Jensen
Vice President
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Action code: WHEN CONVENIENT

Fuel Oil Backflushing Filter

SL2016-615/JFH
May 2016

Concerns

Owners and operators of MAN four-stroke diesel engines, identical types L2024, L2120, L2320H, L2738, L2832H, V28/32S

Summary

Installing an automatic backflush filter in the fuel oil booster/circulation system protects the engine against abrasive particles and impurities in the fuel oil.

Reference is made to:

Engine – operating manual
010.000.023-05 Specification of heavy fuel oil (HFO) and
010.000.023-14 Analysis of operating fluids.



Excessive wear of fuel injector (exhaust holes)

Owners and operators of MAN four-stroke diesel engines.

To ensure the correct cleanliness of the fuel oil and thereby protect the auxiliary engines against abrasive particles and impurities in the fuel oil, a 10 µm (absolute/sphere passing mesh) automatic backflush filter must be installed in the fuel oil booster/circulation system before the branch off to each auxiliary engine. The automatic backflush filter will also serve as an indication of failures in the fuel oil cleaning system and it removes self-generated contamination in the fuel oil booster/circulation system. Installing the 10 µm backflush filter has in more cases extended the service hours of the fuel injection nozzles from as low as 400 to at least 8000 hours.

Engine guides

MAN Diesel & Turbo

P 11 02 1



Automatic back-flush filter

Automatic back-flush filter

To protect the GenSets from foreign particles in the fuel (cat fines attack), must a common **automatic back-flush filter** be installed in the **circulation line**, just before the branching to the individual GenSets. The automatic back-flush filter with a change-over cock and by-pass simplex filter and with integrated heating chamber, has a mesh size of **10 microns** (absolute/sphere passing mesh). The automatic back-flush filter permits a continuous operation and is back-flushed continuously, without any interruptions of flow.

The **continuous back-flushing** significantly prevents adhesion of retained solids to filter surfaces and no manual cleaning of filter elements is needed. The constant pressure drop across the filter, combined with the pressure drop indicator, facilitates the detection of a malfunction in the fuel oil system. The use of filtered oil for the back-flushing process eliminates the need for compressed air.

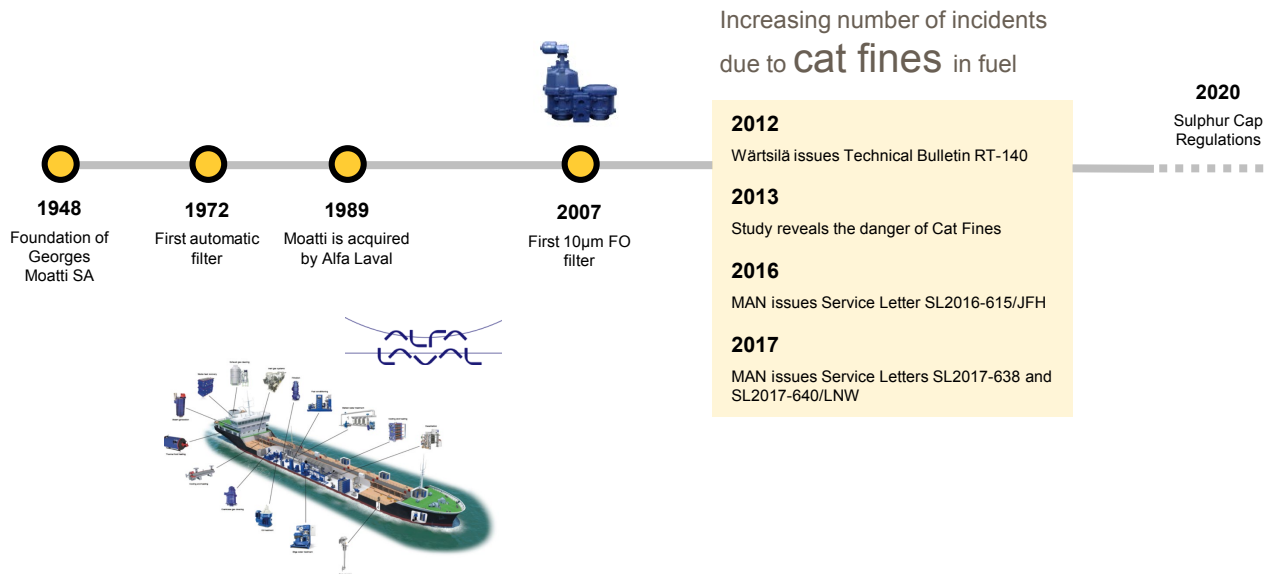
The **diversion chamber** acts as an automatic maintenance-free sludge treatment system, collecting particles back-flushed from the full-flow chamber and cleaning itself to concentrate sludge. The solids settle to the bottom of the diversion chamber, where they are periodically discharged through the drain cock.

Automatic back-flush filter



Solution fully matching
engine makers'
recommendations

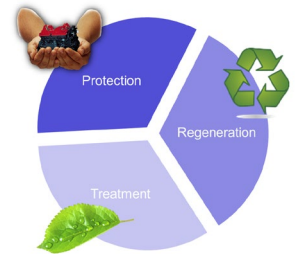
Alfa Laval Moatti - 10µm FO filters



70+ years of experience in filtration

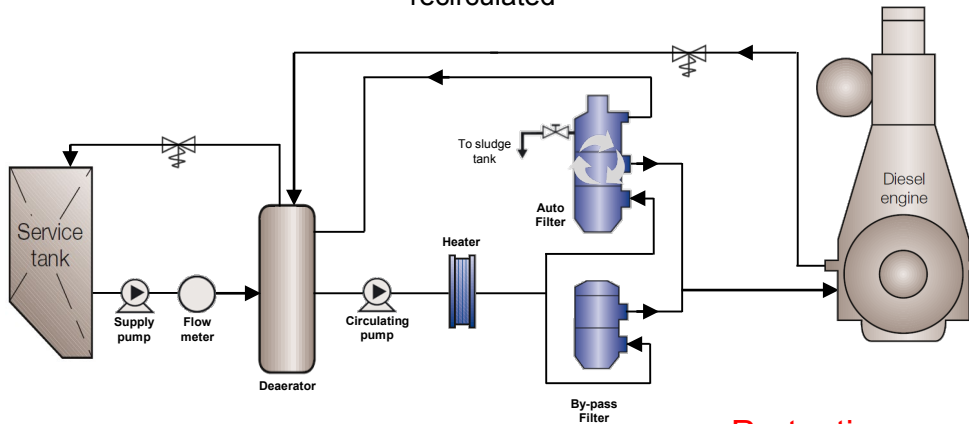
More than 460
10µm filters since 2014

Main features



Treatment:

Automatic and integrated diversion chamber
→ back-flushed oil is treated and can be recirculated



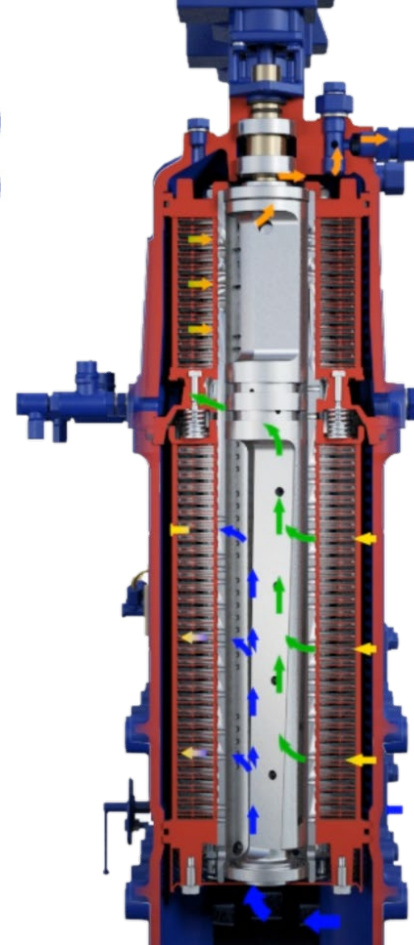
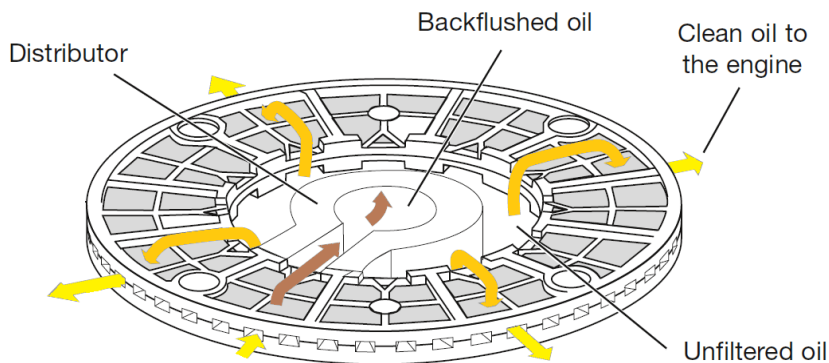
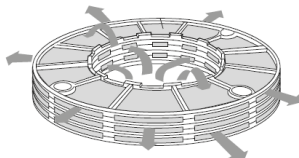
Regeneration:

Continuous back-flushing

Protection:

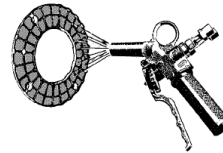
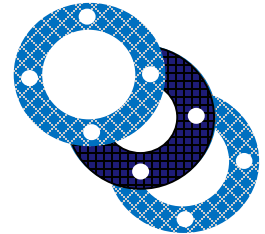
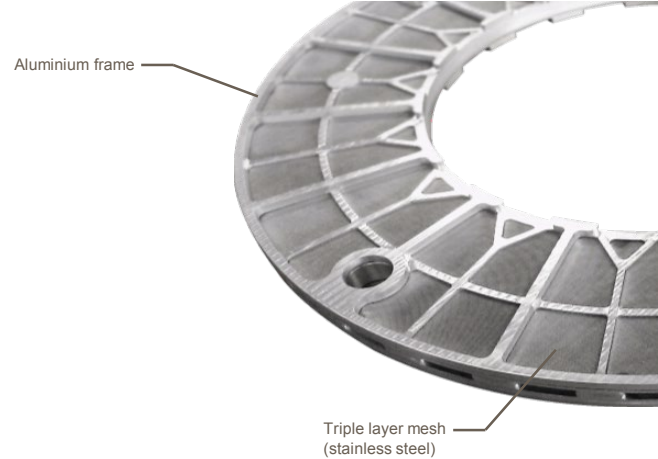
10 μ m mesh – fine
filtration right before the
engine

Working principle



Key benefits

- * 10µm absolute mesh
- * Continuous back-flushing technology
- * Automatic & integrated diversion chamber
- * Fuel oil used as back-flushing medium
- * Low OPEX – long lasting elements
- * Easy maintenance and cleaning



Benefits of upgrading

Case story – upgrading of 34µm filters



Alfa Laval Moatti **10µm** FO filters

- ✓ **Smaller footprint**
- ✓ **Finer filtration**
(better protection of the engine)
- ✓ **Minimized oil losses**
(back-flushed oil recirculated)



Fuel Management

Alfa Laval Fuel Conditioning System

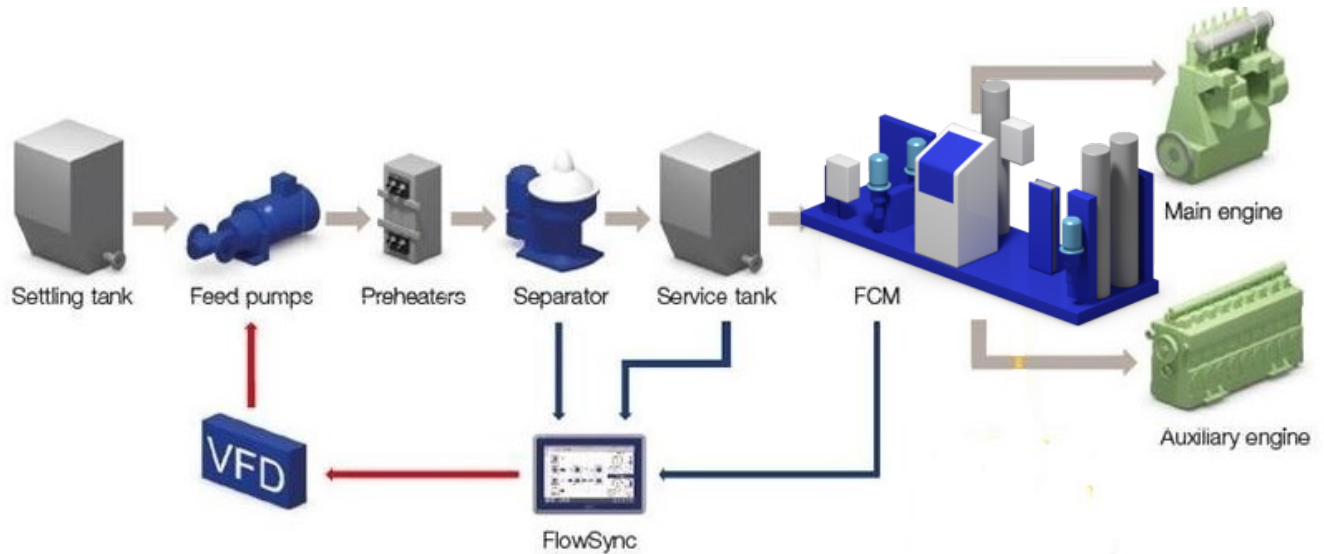
Cynthia Gong

Regional Business Manager

FCM Marine Separation



The Adaptive Fuel Line - Alfa Laval FCM



Alfa Laval FCM

What's Fuel Conditioning System/booster unit

The main purpose of the fuel conditioning system is to ensure proper conditioning of the fuel oil fed from service tank to engines.

FCM ensures that correct flow, pressure, viscosity and temperature, cleanliness to match engine specifications.

Alfa Laval FCM is designed for handling 2020 multiple fuels, in stability and compatibility way, and safely managing by controlled changeover process among them.



Alfa Laval FCM – Main Equipment

Main equipment are Alfa Laval products



Other essential equipment are covered by long term agreements



Alfa Laval FCM – Benefits

Fuel flexibility

- Automatic and remote fuel changeover
- Automatic management multiple fuel, up to 4 fuels
- Dedicated parameters for the conditioning of each of them



Safe operation

- Easy human interface, module design
- Safe fuel C/O process compliant with engine makers requirements
- Fuel log book and documented performance

Global Presence

- One partner in the fuel line
- Global service network to assist on essential equipment
- Global availability of the spare parts



Alfa Laval FCM – Importance Fuel Change-over

◆ Lost propulsion awareness due to incorrect change-over



UNITED STATES COAST GUARD
U.S. Department of Homeland Security

MARINE SAFETY ALERT

Inspections and Compliance Directorate

March 3, 2015
Washington, DC

Safety Alert 2-15

Ultra Low Sulfur Fuel Oil & Compliance with MARPOL Requirements Before entering and while operating within Emission Control Areas

This safety alert is a reminder to vessel owners and operators about the importance of establishing effective fuel oil changeover procedures to comply with MARPOL Annex VI emission regulations. Recently, there have been several reported incidents involving substantial machinery space fuel leakages while vessels were switching fuel oil to ensure compliance. Although such leakages were contained, fuel releases of any kind may result in pollution, injury or death of personnel and shipboard engine room fires. Moreover, many losses of propulsion have occurred in different ports and have been associated with changeover processes and procedures.

◆ MAN's service letter for operation with 0.5% fuel oil

2019-03-08 JUSV/DOJA

MAN Energy Solutions



The injection equipment needs to be protected against rapid temperature changes, as the large temperature changes might otherwise cause sticking or scuffing of the fuel valves, fuel pump plungers or suction valves. The change-over must be carried out at low load (25-40% MCR) and in a controlled manner. The fuel temperature gradient must not exceed 2°C/min (Figure 25 and Figure 26).

MAN Energy Solutions



Action code WHEN CONVENIENT

Operation on fuels with
maximum 0.50% sulphur

SL2019-87G/DOJA
February 2019

Concerns

All MAN B&W ME/ME-C/ME-B/MC/
MC-C, ME-GI and ME-LGI engines.

Summary

For operation on max. 0.50% S fuel:
– The 0.50% S fuel family will show
diverse characteristics, also within
the same fuel grade.
– Avoid mixing different fuel batches.
– Pay attention to the actual fuel
parameters and act accordingly.
– Adjust the fuel temperature to
ensure correct viscosity.

Relevant Service Letters:
SL2018-659, SL2014-593,
SL2017-638, SL2018-663 as well as
the most recent SL on cylinder lubri-
cation (currently SL2014-587).

Change-over process

When changing between fuel batches with different viscosity, it is important to keep the temperature change rate below 2°C/min. If the temperature changes faster, the fuel pumps may stick.

In case the previous fuel and the new fuel are very incompatible and cause excessive sludging and blocking of the auto-filters, consider switching the engine to a distillate (e.g. DMA) in between the two fuel batches to prevent engine blackout due to lack of fuel.

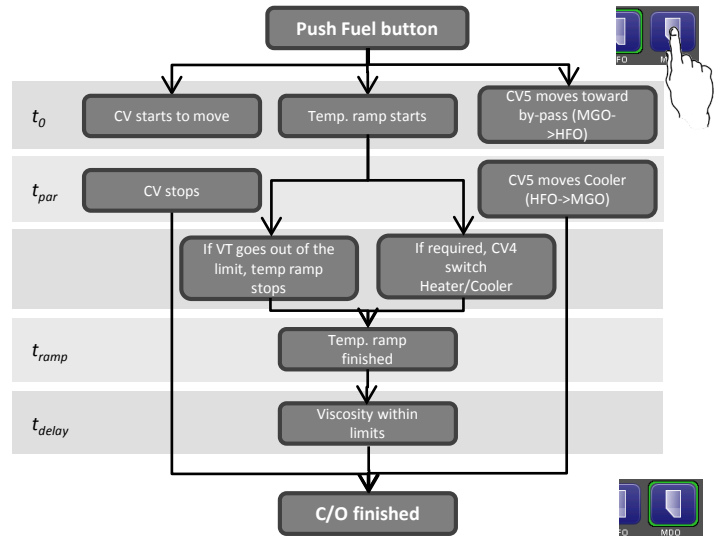
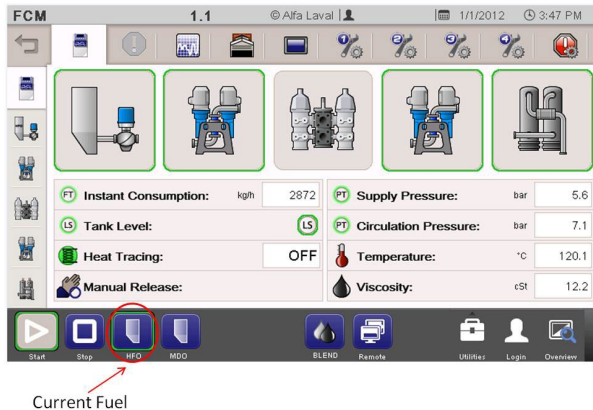
Combustion

In rare cases, fuels may show unfavourable combustion characteristics. Several engine tests made over the years have shown that such fuels do not have major influence on the MAN B&W two-stroke engines. The fuels ignite and burn as for other fuels.

Alfa Laval FCM – Controlled Fuel Change-over

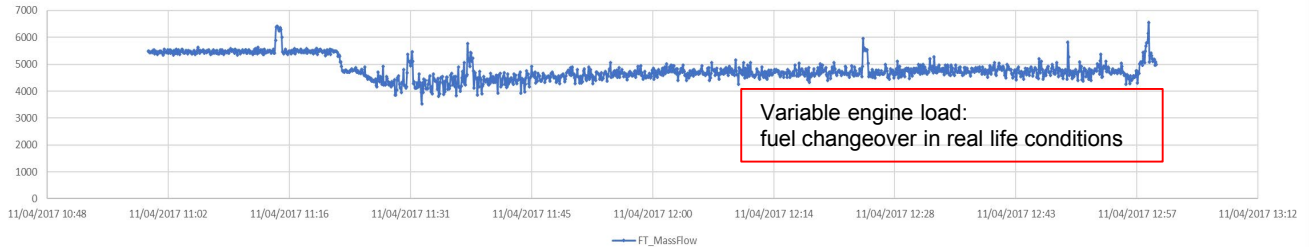
Alfa Laval FCM ensure controlled fuel change-over

- Full automatic fuel changeover procedure in system
- Safe and easy operation by touch panel
- Possibility to set the temperature ramp/gradient and the viscosity limits of the fuel during the changeover process

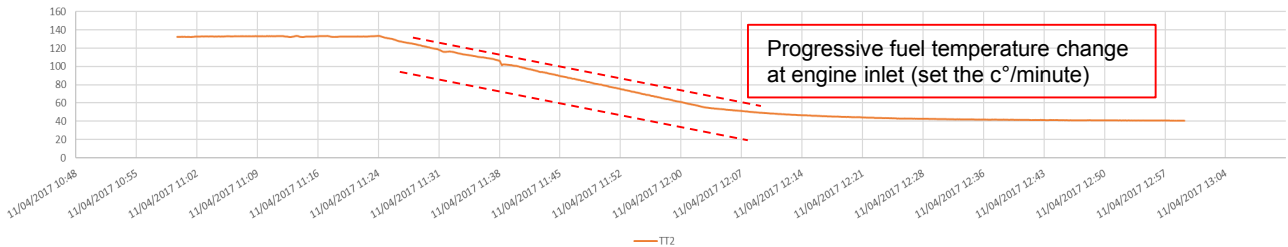


Alfa Laval FCM – Fuel Change-over on Board

Mass Flow Consumption



Temperature trend HFO -> MDO



Viscosity Trend HFO -> MDO



Alfa Laval FCM – Fuel Change-over Documented



Lloyd's
Register

Working together
for a safer world

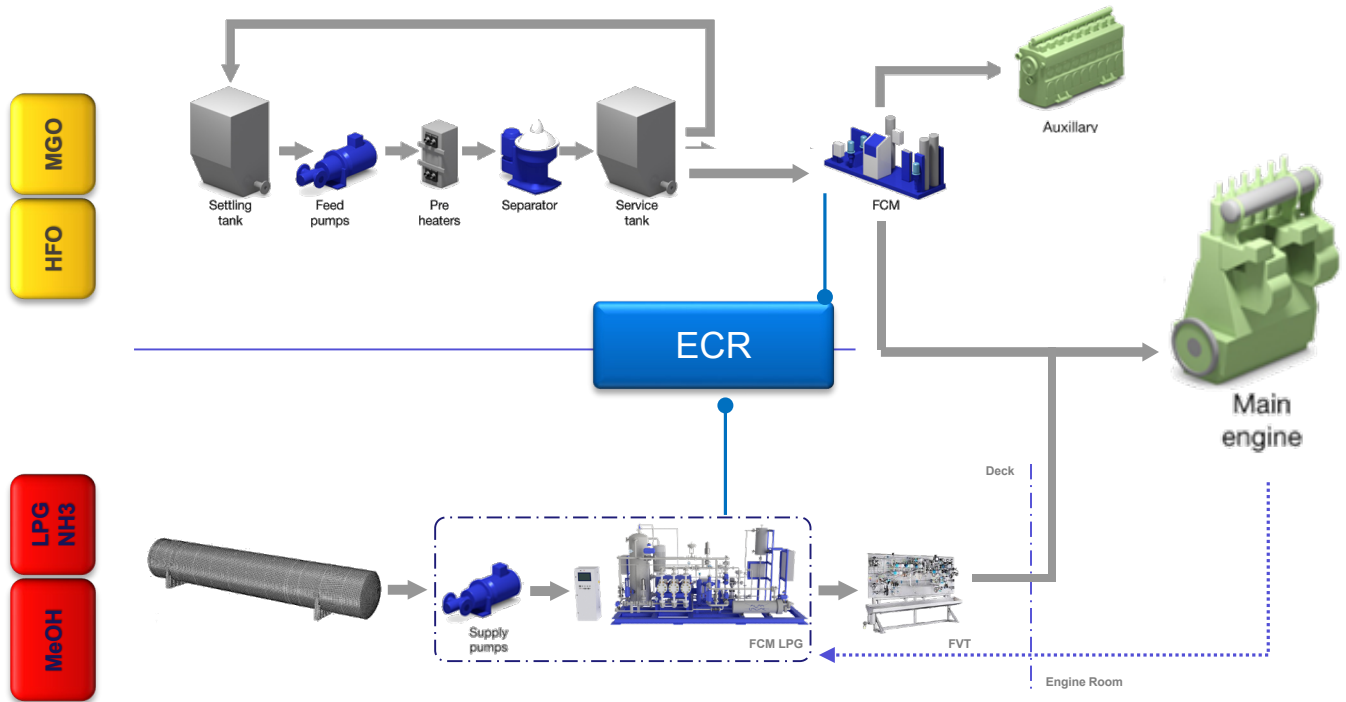
Alfa Laval Fuel Conditioning Module – Automatic Change-over Process

Desk Top Technical Review

Report for: Alfa Laval SpA

The review concludes that in accordance to the subject documentation provided the auto change-over function should provide a controlled and safe switch over taking into consideration the requirements to control the key characteristics of viscosity and the temperature gradient throughout the change-over from a high sulphur fuel to a low sulphur fuel and equally from a low sulphur to a high sulphur fuel oil in a safe and consistent manner.

Alfa Laval FCM – Low Flashpoint Fuel Supply System

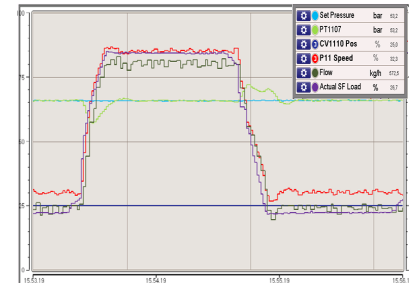


Alfa Laval FCM – Low Flashpoint Fuel Supply System

FCM LPG for ME-LGIP Engines

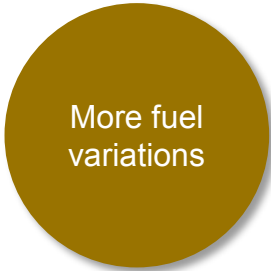
1° unit delivered to MAN-ES Test Center: 4T50ME-X, ~8 MW

- Final Performance Test in MAN
- Marine Design completed : Reactive HP Pump, High energy efficiency, Solid control routines
- Approval in Principle from **ABS**,
Design review and Hazop of Marine design done with **ABS**
- **CIMAC** White Paper on FCM LPG in June'19



Summary


Alfa Laval FCM, link to 2020 Fuels

A large, solid olive-green circle with a subtle drop shadow.

More fuel
variations

- * Automatic and safe change over
- * Handle up to 4 types of fuels
- * Avoid stability and compability issues

Fuel Flexibility

A large, solid black circle with a subtle drop shadow.

Cat Fine
Issues

- * 10 μ Moatti filter as last line of defence

Engine Protection

